VPFlowScope in-line user manual

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VP INSTRUMENTS

VPFlowScope in-line user manual

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1 Warning - Read this first

	Compressed air can be dangerous! Please familiarize yourself with the forces under pressurized conditions. Respect the local guidelines and regulations for working with pressurized equipment.
	Gas flow through pipes follows certain physical laws. These physical laws have serious consequences for the installation requirements. Familiarize yourself with these laws to make sure that the product is installed correctly. Always make sure that upstream length, downstream length, flow, pressure, temperature and humidity conditions are within specifications.
	Precision instruments need maintenance. Check your flow meter regularly and make sure it remains clean. When polluted, gently clean the sensor using demineralised water or cleaning alcohol. **Precision instruments need regular re-calibration.** The *VPFlowScope in-line* is guaranteed for 24 months on manufacturing defects, when used in clean, filtered, oil free and dry compressed air. However, when the air quality conditions are not met, the re-calibration interval may become shorter than 24 months. VPInstruments offers service contracts which cover a one year re-calibration, firmware upgrades and minor repairs.
	Not intended for fiscal metering or billing. Our flow meters are not certified for fiscal metering. Laws on fiscal metering and billing may vary per country or state.
	Do not overestimate the results. The practical measurement uncertainty of *VPFlowScope in-line* is +/- 5%. Do not expect less than 5% measurement uncertainty from any measurement as this is physically impossible due to the nature of turbulent pipe flows. Our products are not intended to be used as a single means to determine compressor capacity.
	Do not open the device. Our instruments are assembled with high precision. Opening this device is dangerous and may destroy the instruments. The IP rating might be compromised. Warranty is voided when you open the instrument.
	Feedback leads to product improvement. Please share your experience with us, as we are continuously improving our products in our commitment to quality, reliability and ease of use. Let us know via sales@vpinstruments.com!

2 Introduction

Congratulations! **You purchased the easiest to use and most complete compressed air measurement tool in the world.** With the *VPFlowScope in-line*, you can monitor and record flow, pressure, temperature, and total air consumption, simultaneously.

Great products deserve great user manuals. We have done our best to make this user manual as complete as possible. New users, please read it carefully to familiarize yourself with our products. Experienced users can check out the Quick start chapter.

Check the packaging box for any inconsistencies. Should there be any shipping damage, notify the local carrier. At the same time a report should be submitted to Van Putten Instruments BV, PO BOX 151, 2600 AD DELFT, The Netherlands.

This manual is dedicated to:
VPS.R080.M050.DXX Where DXX indicates the display type
VPS.R250.M100.DXX Where DXX indicates the display type
VPS.R01K.M200.DXX Where DXX indicates the display type

VPStudio software version 1.0.22
Sensor firmware version 1.19
Display firmware version 2.5.1

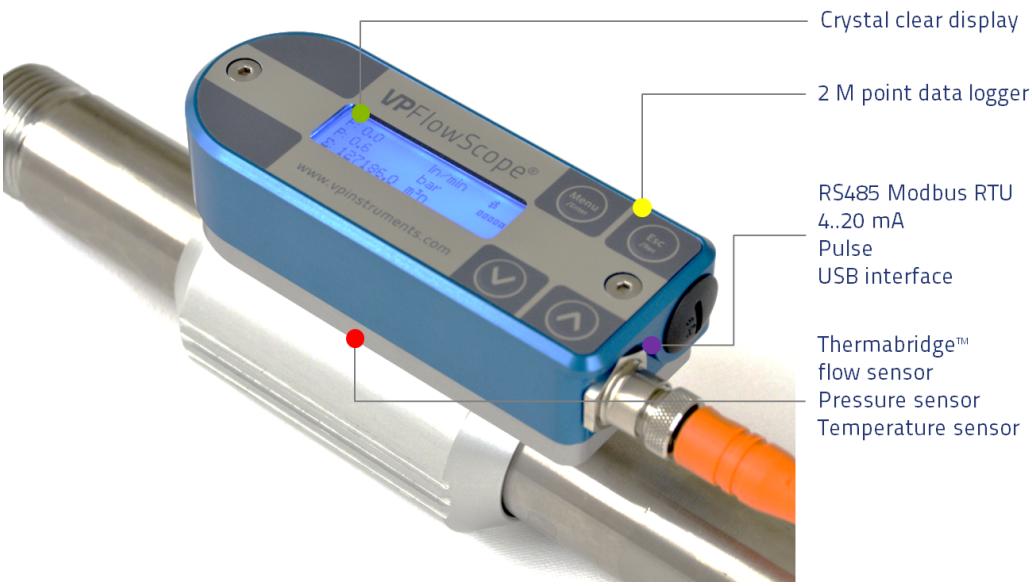
Older software features may not be covered by the contents of this user manual. Please contact us for a service subscription program, which includes software and firmware updates!

Do you like our products and this user manual? Tell others! Do you miss something? Let us know via sales@vpinstruments.com!

3 Product overview

The *VPFlowScope in-line* measures mass flow, temperature and pressure simultaneously. All these parameters are key to proper compressed air measurement and are therefore included in the basic model. All data can be accessed by Modbus RTU, 4..20mA and pulse.

To make the *VPFlowScope in-line* even more complete, various options like a display or data logger can be added to the meter. Configure the ideal flow meter that fits every project.



The *VPFlowScope in-line* is available in three sizes: 0.5, 1" and 2". Additional options are available for all types:

Order Code	Flow range	Option	Display	Option	Connector
VPS.R080.M050	0 ... 80 m^3_n/hr	D0	No display	C5	5 Pin M12
VPS.R250.M100	0 ... 250 m^3_n/hr	D10	Display	C8	8 Pin M12, for remote logging *
VPS.R01K.M200	0 ... 1000 m^3_n/hr	D11	Display + 2M point logger		

* An 8 Pin M12 connector can only be ordered in combination with a D0 model.

3.1 Configuration

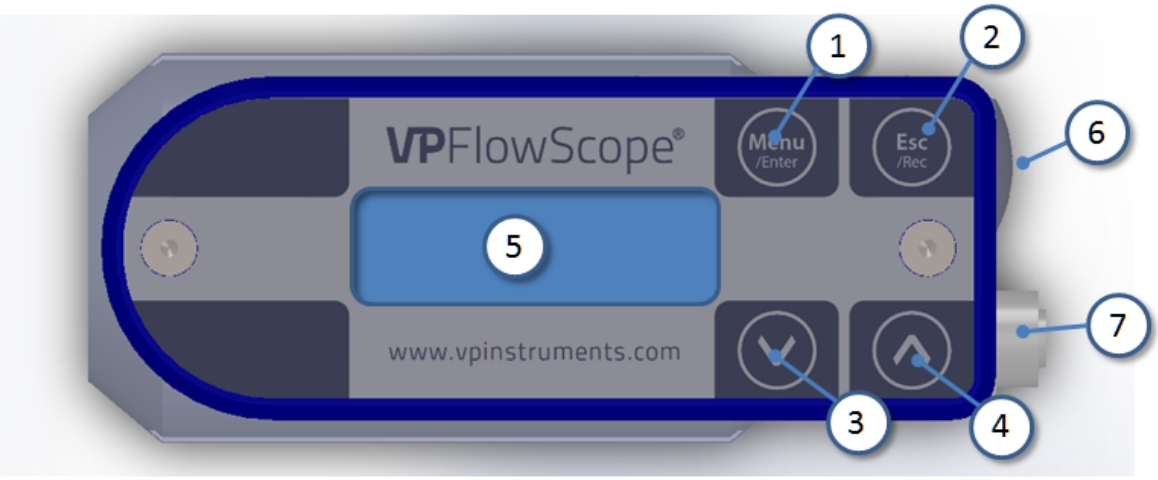
The instruments are pre programmed and ready to use. For configuration of the outputs and data logger, the *VPStudio* configuration software is used. This software can be downloaded from our website. www.vpinstruments.com/downloads

3.2 VPFlowScope in-line D0

The D0 model can be used in applications where local read-out and data logging is not required. With it's various outputs the *VPFlowScope in-line* can be connected to remote data loggers.

3.3 VPFlowScope in-line D10 & D11

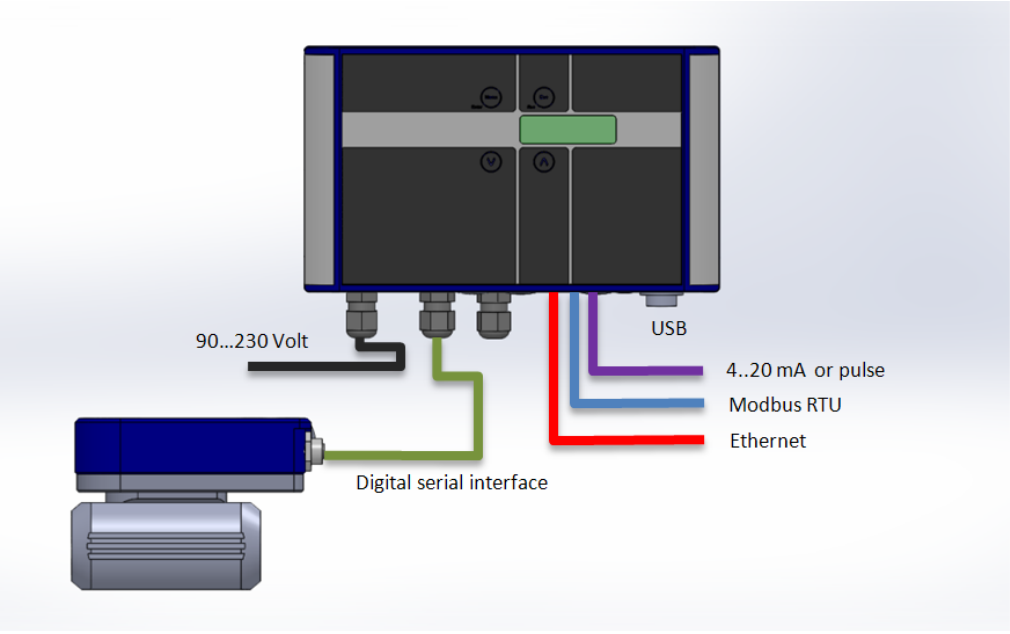
The D10 and D11 models add a display and keypad to the *VPFlowScope in-line*. The display can be used for local real-time read out. All most-used functions are accessible with the keypad. The D11 model also features a 2 Million point data logger.



1. Menu / Enter button
2. Esc / Record button
3. Down button
4. Up button
5. LCD display
6. USB interface
7. M12 connector

3.4 VPFlowScope in-line D0 with the VPFlowTerminal

The *VPFlowTerminal* can be used as a remote display for situations where the local display can't be read. All display features will be available on the remote display.
An 8 wire cable is used to connect the *VPFlowTerminal* and *VPFlowScope in-line*. Therefore the D0 model needs to be ordered with an M12 8-pin connector.



4 Quick start

This chapter contains the basic steps to start using your *VPFlowScope in-line* flow meter. Additional information on all subjects can be found in the next chapters.

1. Unpack
Unpack the meter and check if all items are there and in good shape. A checklist with all items is available on the box.

2. Mechanical installation
- Find the best point of installation for this product. Make sure that all specifications are met.
- For installation of the *VPFlowScope in-line*, the pipe needs to be cut. Mount the *VPFlowScope in-line* between the pipe ends. Use tri-clamp or similar adapters for quick installation and removal.
- For installation with the tubing kit: The connection is BSP outer straight thread [For NPT thread, chase the BSP thread of the pipe ends with a die]; 0.5", 1" or 2" depending on the *VPFlowScope in-line* model.
- For installation without tubing kit: The connection is BSP inner straight thread [It can accept NPT male thread ends]; 0.5", 1" or 2" depending on the *VPFlowScope in-line* model.

See chapter mechanical installation for more detailed information.

3. Electrical installation

3.1 Permanent installation
Connect a cable with 5 Pin M12 connector to the *VPFlowScope in-line*. The cable can be connected to a central data acquisition / building management system or data logger via Modbus, 4..20mA or pulse. See chapter electrical connections for more information.

Apply 12-24 VDC to power up the device. Use a Class II power supply (less than 2 Amps). If the built-in display option is available, it will light up when power is applied.

3.2 Temporary installation
Use a 12 Volt power supply with M12 connector to power the *VPFlowScope in-line*. This quick method is ideal for audits.

4. Data recording
When the data logger is available a data log session can be started by pressing the esc button and then enter. All parameters will be logged with the default logging intervals. These logging intervals can be changed with the *VPStudio* software. This software tool is also used to retrieve the recorded sessions.

5 Measurement

For all parameters the update interval is 1 second. Within this second, multiple samples are taken and averaged to provide a stable and reliable output.

5.1 Flow

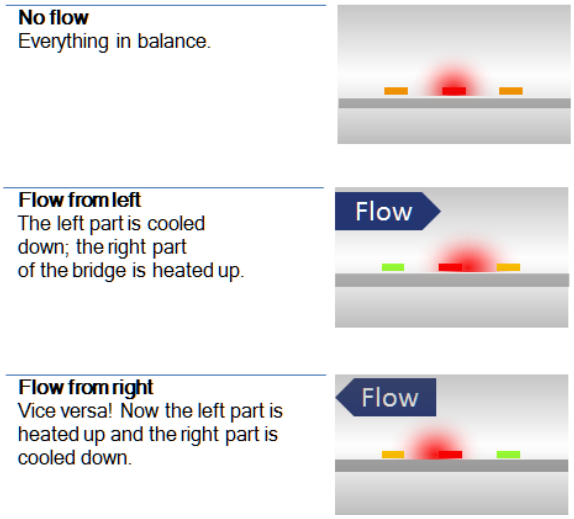
The *VPFlowScope in-line* uses our proprietary insertion type thermal mass flow sensor. There is no bypass flow, which results in a high robustness and less sensitivity for dirt or particles. The flow sensor is directly temperature compensated.

The sensor response signal is directly related to the mass flow rate and can be described by the following formula:

$$Vout = k * \lambda * \rho * v * (Ts-Tg)$$

Vout = output voltage
k = sensor (geometrical) constant
λ = thermal conductivity of the gas
ρ = density of the gas
v = actual velocity in m / sec
Ts = sensor temperature
Tg = gas temperature

The optional bi-directional sensitivity is shown in the picture on the right. In bi-directional mode the negative flow value will show up as a minus sign. The 4..20 mA value needs to be adapted to suit the application. See chapter 9.1 for details.


No flow
Everything in balance.
Flow from left
The left part is cooled down; the right part of the bridge is heated up.
Flow
Flow from right
Vice versa! Now the left part is heated up and the right part is cooled down.
Flow

5.2 Pressure

The *VPFlowScope in-line* features a built-in gauge pressure sensor. The sensor range is 0...250 psi, rounded off this equals 0...16 bar gauge. The sensor cannot measure vacuum, please contact us if you have a vacuum application. The sensor membrane can handle media which are compatible with glass, silicon, stainless steel, Sn/Ni, plating and An/Ag solder

The sensor signal is sampled with 16 bits. The practical resolution is 0.24 mbar on the 0..16 bar scale, which is equal to 0.004 psi on the 250 psi scale

5.3 Temperature

The built in temperature sensor measures the compressed air/ gas temperature. It is mounted in a separate position, to ensure quick response time and low self-heating of the sensor element.
The signal is sampled with 16 bits. The resolution is less than 0.1 deg C.
In a vertical pipe, with flow going down, the temperature sensor may heat up at zero flow conditions, due to the heated flow sensor element. This effect will disappear as soon as there is consumption.

For optimal measurement performance, the *VPlowScope in-line* needs to be in a stable temperature environment. When exposed to quick temperature changes or large temperature changes (for example taking the unit from outdoor to indoor during winter time, or when mounted downstream of a

heat regenerated drier) the temperature compensation may lag behind, which may result in significant measurement errors.

5.4 Totalizer

The totalizer keeps track of the total consumed amount of compressed air in normal cubic meters, or in scf depending on which unit you choose to read out. The refresh interval is 1 second, actual measurement data will be available on the display and by Modbus. For back up reasons, the totalizer value is written to it's internal memory with an interval of 15 minutes. A power down might result in maximum 15 minutes of totalizer data loss.

In bi-directional operation, negative flow is subtracted from the totalizer. The totalizer will count backwards as the compressed air is delivered back to the supply side. The totalizer can only be reset to zero. It's not possible to set it to a different value.

6 Mechanical installation

First select the right installation point. The installation point is crucial for the right measurements. Sources of error can be: installation effects, unknown flow profiles, swirls, pressure and temperature effects, humidity effects or oscillations in the flow. To ensure the highest possible accuracy of flow measurement, the installation and piping instructions must be followed. Therefore read this paragraph carefully.

Take into account:
- Choose a site which is accessible, which allows ease of wiring and maintenance, and which allows you to still read and access the display if possible.
- Meet the specifications of the *VPFlowScope in-line*. If the specifications are not met, for instance the pressure or temperature level is too high; this will cause inaccurate flow measurement and can even damage your flow meter.

Avoid:
- Excessive heat, check the temperature range of your *VPFlowScope in-line*.
- Potential water damage on the outside. Avoid areas of high humidity and avoid dripping. Be aware that the *VPFlowScope in-line* is not watertight, it is only IP65 (when mated with the USB protection cap).
- Corrosive atmosphere where possible.
- Electrical problems (high voltage/ high power).
- Mechanical vibration and danger (walking bridges, fork lift trucks).
- Any source of potential error.

Warning: These devices are only for use with Air, Nitrogen, Argon, Helium, Carbon Dioxide and other non hazardous, or non combustible gases. The maximum working pressure is 16 bar (250 psi)

6.1 Piping table

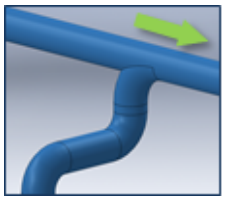
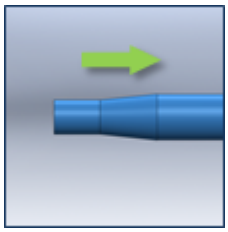
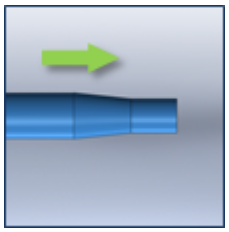
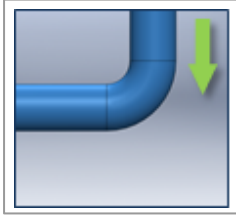
General rule: At least 20 times the pipe diameter upstream and at least 5 times the pipe diameter downstream needs to be applied, to avoid any distortion of the flow profile.

For some exceptions the upstream length needs to be longer, or can be shorter. Check the piping table below for your application.

If possible, you can always choose a longer upstream length, as these are minimum values. The up- and downstream lengths are used industry wide as guidelines, but will never be a guarantee for obtaining the “true value”. So always be careful and try to build up your own experience from practical measurements

Piping table

The following table provides a guideline for proper distances between upstream or downstream objects and the *VPFlowScope in-line*. The upstream length is the length between the last non-straight object and the *VPFlowScope in-line*. If the upstream length is straight, and the distortion is downstream of the *VPFlowScope in-line*, you can use the column "downstream length" as a guideline. In very complex situations, with multiple up- and downstream objects, you should consider another location.

Picture	Description	Upstream length	Downstream length	Effect
	Complex feed-in situation (header)	40 * D[1]	10 * D[1]	Flow profile will be distorted
	Double elbow, multiple elbows following each other	40 * D[1]	10 * D[1]	Distorted profile + swirl
	Diameter change from small to large (gradual or instant)	40 * D[1]	5 *D[1]	Jet shaped flow
	Diameter change from large to small (gradual change, between 7 and 15 degrees)	10 * D[1]	5 * D[1]	Flattened flow profile
	Single elbow	30 * D[1]	10 * D[1]	Distorted flow profile

[1] = inner diameter

6.2 Installation without tubing kit

When you order your *VPFlowScope in-line* as a base model only, it is delivered without up- and downstream piping. You can install it directly between two threaded pipe ends. Please be aware that the connection between the pipe and the *VPFlowScope in-line* is very important. Any diameter mismatch will result in higher inaccuracy. For example the inner diameter of the pipe may affect the reading. Depending on the pipe wall thickness, the inner diameter can be smaller, which results in a higher measurement value. If you want to be sure of the connection, ask us to supply you with the piping kit.

The connection is BSP inner straight thread; 0.5", 1" or 2" depending on the *VPFlowScope in-line* model. For NPT thread, chase the BSP thread of the pipe ends with a die.

6.3 Installation with tubing kit

If you ordered the tubing kit or a full start kit, the *VPFlowScope in-line* is delivered with an optimized up and downstream piping kit, to ensure at least 20 times the pipe diameter (for 0.5" and 1") upstream length. For economical reasons, the 2" model is delivered with the pipe length **15 times the pipe diameter upstream**. For optimum results, see the piping table and create additional upstream pipe length when required.

Check the pipework and the O-rings, which are pre-mounted on the pipes. Apply a little O-ring grease to ease the mounting process. Screw both pipes into the *VPFlowScope in-line*. Gently screw the pipes into the flow meter inlet. Turn it all the way in, until the end of the pipe reaches the bottom of the inlet hole

You can install the *VPFlowScope in-line* directly between two threaded pipe ends. The connection is BSP outer straight thread; 0.5", 1" or 2" depending on the *VPFlowScope in-line* model. If necessary you can ask our sales team to supply NPT thread on the tubing, or you can chase the thread yourself with a die.

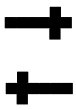
7 Display

The optional display module unlocks some new cool features!

- LCD display with 3 lines of real time data, refreshed every second
- Key pad with menu to configure the main settings
- USB interface
- Optional data logger

7.1 Display status icons

Some status icons show feedback on the meters' status. Below is a list with explanation

Icons	Description
	Sensor module is properly connected and supplied with power
	No communication with the sensor [Check external power when disconnected]
	A blinking dot will indicate that a data session is active
	2 rotating arrows indicate that there is communication with the computer
	The display is locked. The menu can not be accessed
	Memory indication. Each block indicates 20% of memory usage. The blocks start to blink if the memory is more then 95% full

7.2 LCD display

The LCD display provides 3 rows for real time data. Each row can be configured in the menu by selecting the desired parameter for this row.
Available options are listed in menu -> display.

7.3 Data Logger

The optional built-in data logger offers you 2 Million data points. Enough to measure all three channels 1 x per second for more than a week. A little warning though: more data does not always lead to better insight in savings!

Use the following guidelines for the intervals

Application	Flow	Pressure	Temperature
Standard energy management application	5 min	5 min	5 min
Machine testing - quick fluctuations	1 sec	1 sec	1 sec
Audit - one week	10 sec	10 sec	5 min
Audit - one month	30 sec	30 sec	5 min

Multiple sessions can be recorded. When a session is started, a separate session will be recorded. It's not possible to append to an existing session.

When a power failure occurs during recording, the session will be stopped. When power is restored, a new session will start automatically.

7.4 Keypad

The key pad contains 4 buttons to control the *VPFlowScope in-line*.

1	Menu / Enter	Used to enter the (sub)menu or to confirm a setting
2	Escape / Record	Will start a data logging session when in the data acquisition screen. Will return from a (sub)menu when not in the data acquisition screen
3	Button down	Navigate down in the menu
4	Button up	Navigate up in the menu

Special key functions

- Lock display

  In the main screen, press up and down simultaneously to lock or unlock the display. A lock icon will appear in the right lower corner of the screen. The lock function will block keypad functionality.

- Clean re-boot.

  Hold esc pressed when turning the power on. Use this option when a display will not start up or if a session won't stop. This can happen due to subsequent power failures at the moment that the memory is almost full.

7.5 Menu

The menu is categorized into 3 main items which contain their own sub menu items. The complete menu structure is shown below:

1. Settings
   1. Display
   2. Date and Time
   3. Modbus address
   4. Display dimtime
   5. Display orientation
2. DAQ Sessions
   1. New Session
   2. Delete all
3. Advanced
   1. Reset

1 Settings

The settings menu can be used to change both functional parameters as display settings.

1.1 Display

The main screen of the display contains 3 rows to display measurement values. Via this menu measurement values can be assigned to these rows. Available options in the menu are:

Measurand	Available units	Description
Empty	-	Leave this display row empty
Flow	m_n/sec m^3_n/h l_n/min CFM m^3/min sfps	Normalized
Pressure	Bar Psi	Gauge
Temperature	Deg C Deg F	
Totalizer	m^3_n	Normalized
Custom		5 available units to be configured with *VPStudio*. Multiply an existing unit with a user defined factor.

1.2 Date and Time

Adjust date and time settings. First enter the menu option and set the date with the key pad. The date is formatted as: DD-MM-YYYY. After setting the date, confirm with enter and then enter the time settings in format: HH:MM:SS, again confirm with enter. The new date will become active immediately.

Date/time settings are kept actual by the real time clock until long power down. Date and time will also be synchronized with the computer when used with *VPStudio*.

1.3 Modbus address
The Modbus address can be changed with this option. Use the up and down buttons to change the number. Available numbers 1 – 247.
After setting the number press enter to save the address. The power of the *VPFlowScope in-line* needs to be cycled to activate the new address.

1.4 Display dimtime
The display backlight dimtime can be adjusted here. The default dimtime is set to 10 seconds. Other Available options are:
- Fading off. The backlight will remain on.
- 5 till 30 seconds with steps of 5 seconds.

Confirming with menu will make this setting immediately active.

1.5 Display orientation
The text on the display can be set upside down for installations were the *VPFlowScope in-line* is installed in this way. Enter the menu item and select the desired orientation with the arrow keys. Confirm with enter to make these settings active.

All keys will maintain their function.

2 DAQ Sessions

The *VPFlowScope in-line* contains an optional 2 Million point datalogger. When available, the menu is set to start and stop the sessions or to delete all present data.

2.1 Start session
The session will be started when you push the enter button after selecting this option. When the session is started, the menu will close and the main screen will be shown. A blinking dot in the right upper corner will indicate the running session. The menu will be blocked when a session is active. The session can be stopped by pressing the esc button.

2.2 Delete all
All sessions will be deleted. It is not possible to delete just a single session.

3 Advanced

3.1 Reset
Reset the device. All peripherals will be reinitialized. This option is also needed when updating the display firmware.

8 VPStudio software

The *VPFlowScope in-line* can be read out and configured with the *VPStudio* software. This software can be downloaded from www.vpinstruments.com.
In case of basic configuration and read out, use the free edition. If real time logging is required, request a license code by our sales department.

A quick start is shown below, read the *VPStudio* manual for more information. This manual can be downloaded from www.vpinstruments.com/downloads

Connect the *VPFlowScope in-line* to the computer
The *VPFlowScope in-line* can be connected to the computer with the M12 connector through the JB5 interface box. This interface box combines the power and data signals. Power up the device by connecting the 12VDC power supply to the JB5 interface box. An RS485 to USB converter can be used to connect the JB5 interface box to the computer.
When a display is available, the *VPFlowScope in-line* can also be connected by USB. When connected via USB, you can only download data log sessions and configure the display. For full functionality you need to connect an additional DC power supply via the M12 connector. We offer a convenient power supply for this purpose (VPA.0000.200)

Install USB drivers
A driver needs to be installed for the RS485 to USB convert or USB interface. These drivers might be installed automatically by your windows system or need to be installed manually. All drivers are available on our website www.vpinstruments.com/downloads.

Configure the *VPFlowScope in-line*
- Start the *VPStudio* software
- In the left white window, right click to open the menu. Now click add device
- Click the scan button to search for the right COM port. Select it and click add
- Enter a name for the device
- Now select serial for RS485 converter or USB if the meter is connected with USB
- Set the communication parameters if available
- Click add.

***VPFlowScope in-line* sensor read out**
- Click on the device in the explorer window to read out the settings
- The status tab provides general information
- The installation tab is used to configure the settings

***VPFlowScope in-line* display read out [option]**
- Click on the plus icon to unfold the display icon
- Click on display to read out the display settings
- The status tab provides general information
- The installation tab is used to configure the settings
- Click sessions below display to retrieve session data.

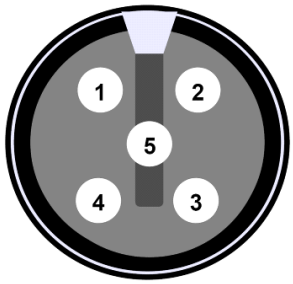
9 Electrical connections

Tip: Use a shielded cable of good quality to connect the meter. Connect shield to safety ground on one point.
For portable, non-critical applications, a switched mode 12 V DC, 1A power adapter may be used. Switched mode power supplies that are of poor quality, might affect the accuracy.

NEVER USE AC POWER. THIS WILL VOID WARRANTY AND BRING PERMANENT DAMAGE TO THE ELECTRONICS. THE INSTRUMENT MIGHT BE DAMAGED BEYOND REPAIR.
CONNECT THE M12 CONNECTOR BEFORE POWERING UP THE INSTRUMENTS.

The *VPFlowScope in-line* provides a 4..20 mA / pulse output and a Modbus output. All signals are present in the M12 connector. These outputs can be used to connect the *VPFlowScope in-line* to a building management system or energy monitoring system like *VPVision.*

Pin	Signal	Wire color
1	+12...24 VDC	Brown
2	0 Volt	White
3	4..20 mA signal, active	Blue
4	RS485 A	Grey
5	RS485 B	Black



9.1 4..20mA output

The 4..20mA output is an active, non- isolated linearized output that can be used to connect the *VPFlowScope in-line* to a control system, a building management system or any 4..20 mA based SCADA system.

There is one 4..20 mA output available on the *VPFlowScope in-line*. This output can be assigned to one of the measurement parameters, only one can be selected. For each measurand, a number of units is available. The factory default is mn/sec.

Measurand	Unit
Flow	m_n/sec
Flow	m^3_n/hr
Flow	l_n/min
Flow	SCFM
Flow	m^3_n/min
Flow	sfps
Pressure	bar
Pressure	psi
Temperature	deg C
Temperature	deg F

For scaling purposes, the zero and span matching 4 and 20mA can be modified. This will not effect the original measurement range. The zero and span are only used to increase or narrow the resolution. For bi-directional measurement, the zero value needs to be set negative. See below table for factory defaults.

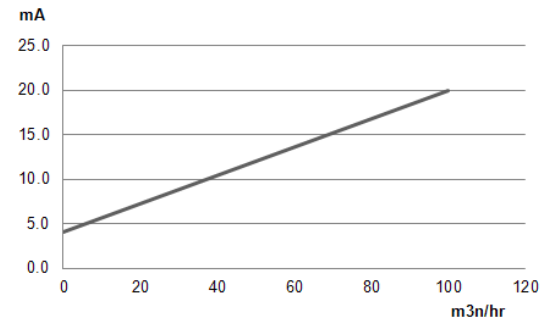
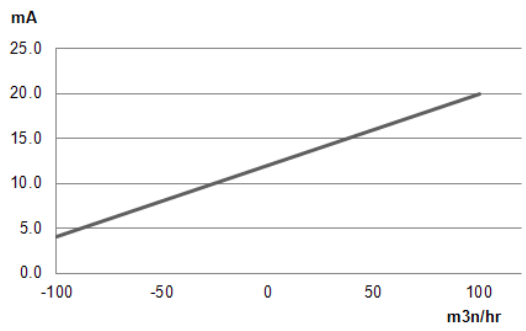
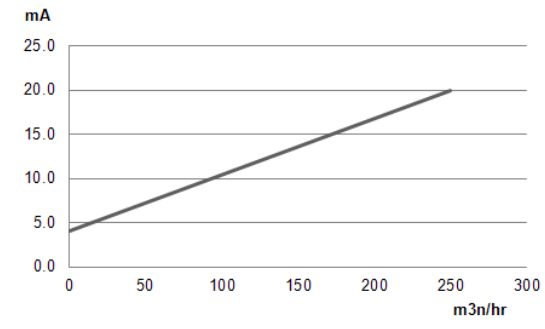
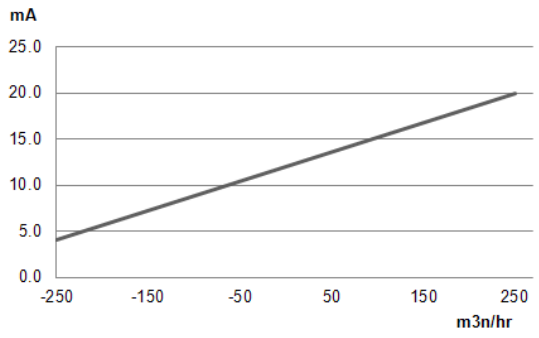
Mode	Zero	Span	Idle output
Single direction	0% flow range	100% flow range	4 mA
Bi directional	-100% flow range	100% flow range	12 mA

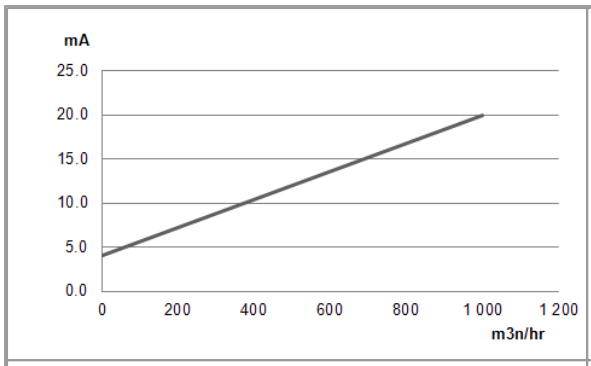
Configuration with *VPStudio*
VPStudio has graphical visualization for the 4..20mA settings. The actual settings will be shown next to the factory settings.

With *VPStudio*, in the pull down menu, you can choose above units to assign to the output. Adjust the zero and span for scaling.

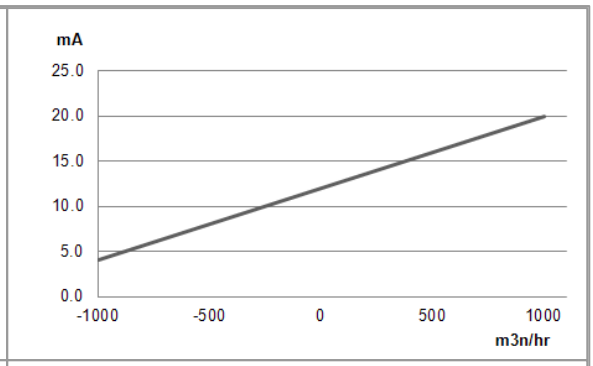
Changing to volumetric units, the programmed diameter is calculated in the settings. So change the diameter first, then the analogue settings. *VPStudio* provides feedback while you are changing the settings. Use “set default” to go back to the factory default.

4..20mA output

Single direction	Bi directional
	
0.5" 0% | 100% flow	**0.5" -100% | 100% flow**
	
1" 0% | 100% flow	**1" -100% | 100% flow**

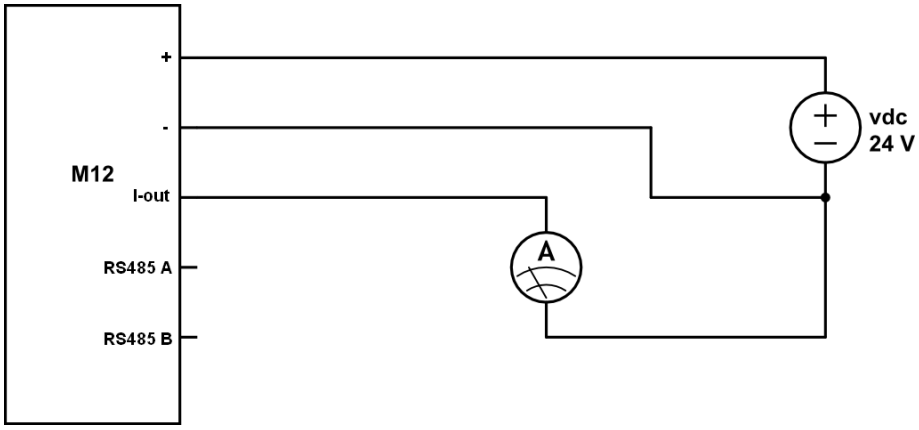


2" 0 | 100% flow



2" -100% | 100% flow

Electrical scheme:



The current meter is placed in between the current output and the power supply ground. You can also use a digital multimeter to test the current output.

9.2 Pulse output

The *VPFlowScope in-line* features a low-frequency active pulse output. The pulse is a 'non potential' free output as it acts like a controlled current output. To make it passive, an external isolator can be used.

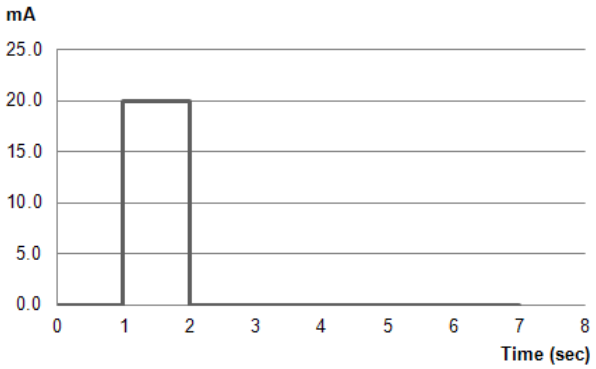
The pulse interval can be set with the *VPStudio* software. A pulse from 0..20mA will be generated when the interval exceeds. The maximum pulse frequency is once per 2 seconds. If the pulse interval is set to small, a continuous pulse (20mA high level) will be the result.

The pulse output is connected to the internal totalizer value. When the totalizer has increased by the pulse interval, the pulse will be generated. As it is not possible to generate a negative pulse, negative flow can not be indicated by pulse. In case of negative flow, the internal totalizer will count backwards. Pulses will not be generated until the same amount of positive flow has been added to the totalizer again. In this way we ensure that the pulse output will always be synchronized with the internal totalizer of the *VPFlowScope in-line*. In case of continuous negative flow, consider to swap the flow meter direction.

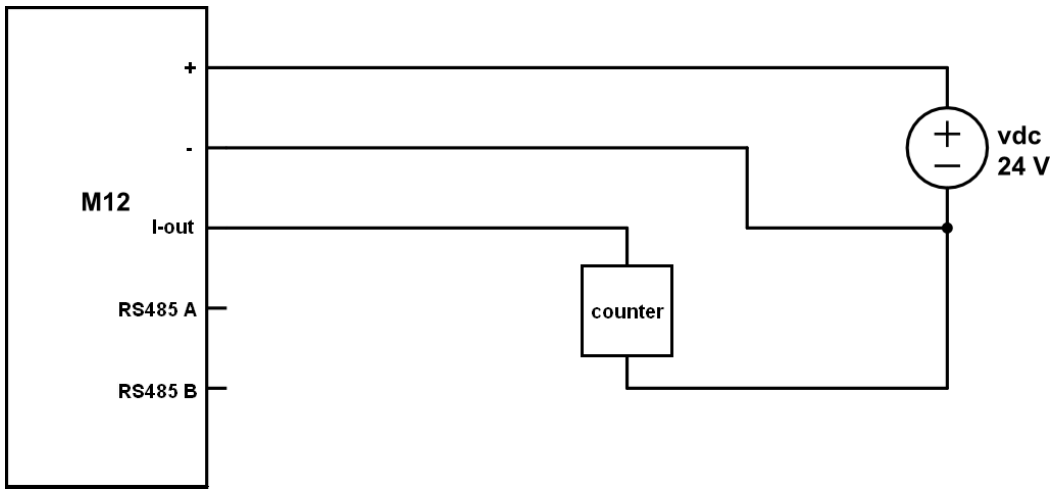
Default settings

Diameter	Diameter	Pulse interval
< 25 mm	< 0.5 inch	0.1 m^3_n
> 25 mm and < 45 mm	> 0.5 inch and < 1 inch	0.2 m^3_n
> 45 mm	> 1 inch	1 m^3_n

Pulse output



Electrical scheme:



9.3 Modbus interface

Introduction to Modbus

For new users, a complete introduction on the Modbus standard can be found on www.modbus.org. See the document Modbus_over_serial_line_V1_02.pdf, which can be downloaded from their website. We strongly recommend to download and read this information carefully.

The *VPFlowScope in-line* can be used in multidrop Modbus networks. Upto 247 *VPFlowScope in-line's* can be placed into one daisy chain. However, due to bandwidth restrictions we recommend to split up daisy chains. For a data polling rate of once per second, the maximum number of *VPFlowScope in-line's* is 8, when flow, pressure, temperature and totalizer are read out.

All measurement parameters are available through Modbus in floating point and integer format. The data will be refreshed every second. Maximum polling interval is 10ms.

Placing multiple devices in a multidrop network will cause voltage drops. The minimum supply voltage is 12VDC. In networks with more then 8 devices or longer then 200 meter, ask your local contractor for advice.

Communication settings

The RS485 communication settings can be changed with *VPStudio*. Below shows the available options

- Baud rate: 9600 | 19200 | 38400
- Stop bits: 1 | 2
- Parity: None | Even | Odd

The Modbus settings can be changed with *VPStudio*, the hardware address can also be changed with the keypad when available. Below shows all available options

- Hardware address: 1-247
- Integer multiplier: 1-1000

Data format

Function code 0x03 for reading(Holding register)
Function code 0x10 for writing (Holding register)
32-bit Floating point Little endian
32-bit signed Integer Little endian

Register map

The actual measurement data is placed in holding registers. To read out data, you will need to use the corresponding holding register. All data is stored in 2 16-bit registers with below register number as start address. Read out the data with this start address and length 2.

Decimal	HEX	Description	Type	Read / Write
16	0x10	Flow in m_n/sec	32-bit integer (x10)	Read
17	0x11	Flow in m^3_n/hr	32-bit integer (x10)	Read
18	0x12	Flow in l_n/min	32-bit integer (x10)	Read
19	0x13	Flow in SCFM	32-bit integer (x10)	Read
20	0x14	Flow in m^3n/min	32-bit integer (x10)	Read
21	0x15	Flow in sfps	32-bit integer (x10)	Read
32	0x20	Pressure in bar	32-bit integer (x10)	Read
33	0x21	Pressure in psi	32-bit integer (x10)	Read
64	0x40	Temperature in degC	32-bit integer (x10)	Read
65	0x41	Temperature in degF	32-bit integer (x10)	Read
128	0x80	Totalizer in m^3_n	32-bit integer (x10)	Read / Write*

* Writing to the totalizer will reset the totalizer to zero.

Decimal	HEX	Description	Type	Read / Write
8	0x08	Diameter	32-bit Floating point	Read
9	0x09	4..20mA Max	32-bit Floating point	Read / Write
10	0x0A	4..20mA Min	32-bit Floating point	Read / Write
11	0x0B	4..20mA Unit	32-bit Floating point	Read / Write
24	0x18	Flow in m_n/sec	32-bit Floating point	Read
25	0x19	Flow in m^3_n/hr	32-bit Floating point	Read
26	0x1A	Flow in l_n/min	32-bit Floating point	Read
27	0x1B	Flow in SCFM	32-bit Floating point	Read
28	0x1C	Flow in m^3_n/min	32-bit Floating point	Read
29	0x1D	Flow in sfps	32-bit Floating point	Read
40	0x28	Pressure in bar	32-bit Floating point	Read
41	0x29	Pressure in psi	32-bit Floating point	Read
72	0x48	Temperature in degC	32-bit Floating point	Read
73	0x49	Temperature in degF	32-bit Floating point	Read
136	0x88	Totalizer in m^3_n	32-bit Floating point	Read / Write*

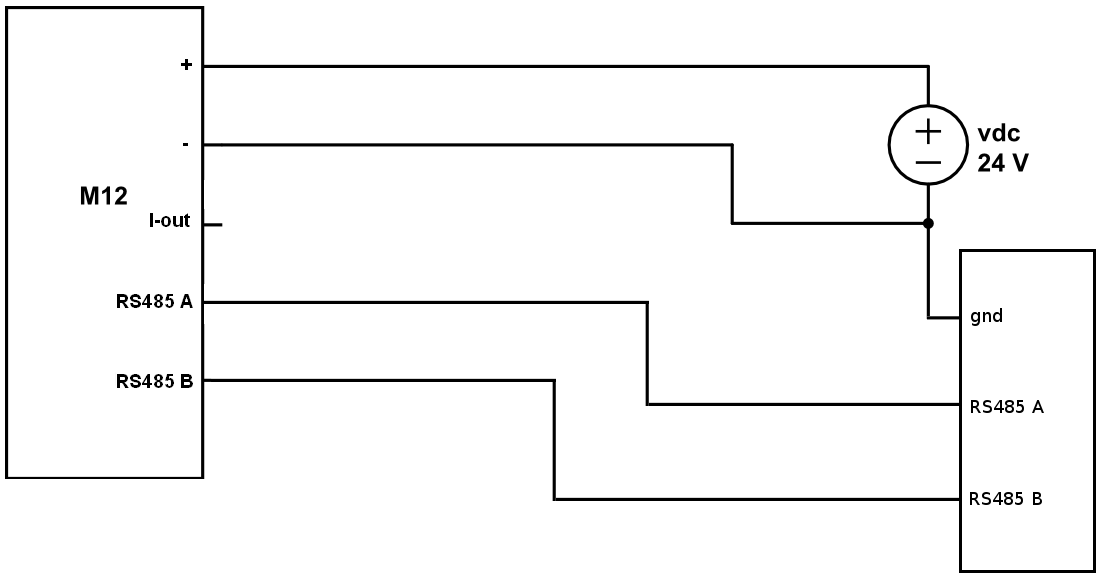
* Writing to the totalizer will reset the totalizer to zero.

Available write operations

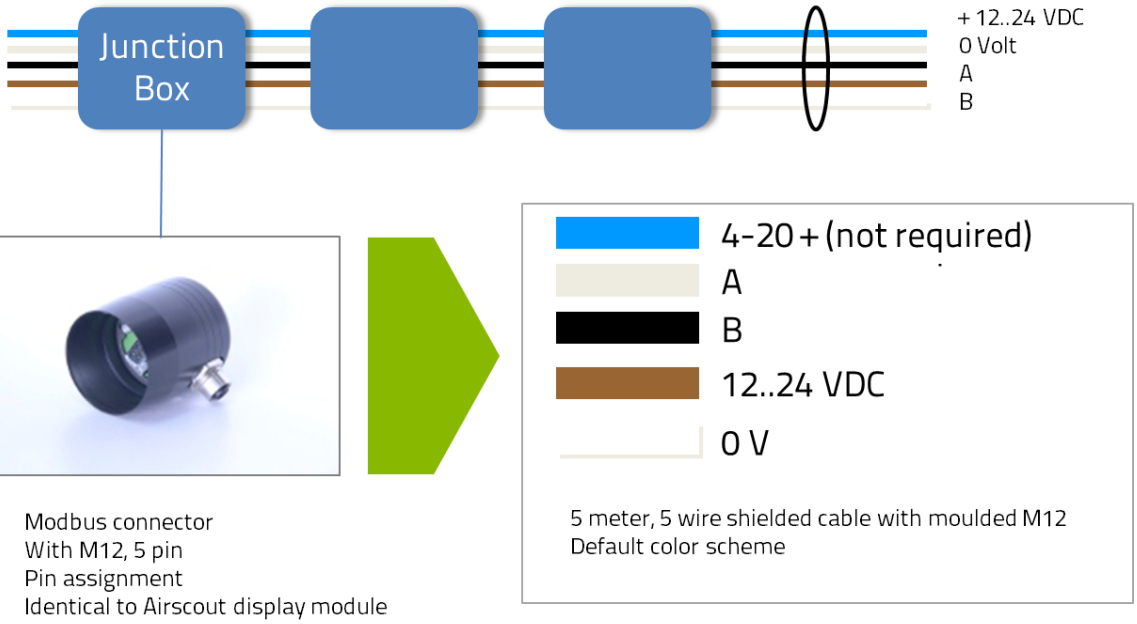
Option	Data	Description
4..20mA unit	0 1 2 3 4 5 6 7 8 9 Other	m_n/sec m^3_n/hr l_n/min SCFM m^3_n/min sfps bar psi °C °F m_n/sec
4..20mA min	Decimal value	
4..20mA max	Decimal value	
Totalizer	Integer or floating point type depending on register type	Will reset the totalizer to zero

Electrical scheme:
For a one-to-one connection with a PLC or a different type of RS485 converter, please see the wiring

scheme below. When short wiring is used, a termination resistor is not needed. For longer wires (>10m), please read RS485 related literature. The ground (common) should be connected to the readout device, so you will need three wires to establish the connection.



Modbus chain:
If multiple Modbus devices are connected in one chain, the configuration as shown below needs to be used. The trunk line goes from the master to all devices making a drop down to each device. The cable length from the trunk line to the Modbus device needs to be as small as possible. Junction boxes are used to make the T junction. The end of the trunk line needs to be terminated with a 120 Ohm resistor. This termination is easily made with the jumper swith and pre-installed resistor inside the junction box. WARNING: make sure that only ONE termination resistor is active and all others are inactive, otherwise the Modbus power consumption will dramatically increase and the signal will be lost.

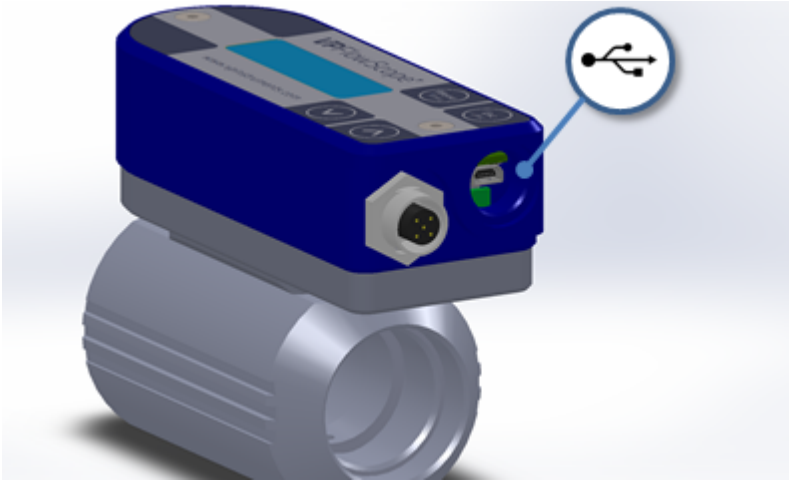


9.4 USB interface

The *VPFlowScope in-line* D10 and D11 model offer a built-in USB interface for configuration and data log session retrieval. The USB interface is protected by an IP65 rated nylon cap. IMPORTANT: the IP65 rating may be compromised when this cap is damaged or not placed back in a proper manner.

To ensure proper sealing, the cap must be greased with a little o-ring grease or vaseline grease. Make sure that the grease is not in contact with the electrical connector!

A standard USB cable with mini connector can be used for connection to a PC or laptop. The USB interface is not designed for permanent use.



10 Service

The *VPFlowScope in-line* needs regular maintenance to ensure that the product is functioning properly. Especially when the product is used for mobile air audits, we recommend inspecting the instrument before and after every audit to ensure that the product has not been damaged. For precision measurement equipment such as the *VPFlowScope in-line*, a proper maintenance program is key to reliable measurement results and a long product lifetime.

10.1 Software and firmware updates

News on software and firmware updates can be found on www.vpinstruments.com, or are provided by your local re-seller. The *VPFlowScope in-line* sensor can be updated via the RS485 port. The USB interface is used for updating the firmware of the display. Instructions on the update procedure can be found in a separate instruction leaflet, which is distributed on request. Upgrading is only possible for authorized technicians, at own risk.

10.2 Recalibration

To keep your *VPFlowScope in-line* in best shape, it needs recalibration. The recommended recalibration date can be found in VP*Studio*, when you read out your *VPFlowScope in-line*. Keep close eye on this date. We advice annual recalibration.

10.3 Service subscriptions

VPInstruments offers several Service Subscriptions. Enrolling in the Service Subscription Program helps you get the most out of your measurement equipment. We keep your equipment in excellent shape, as we offer an annual re-calibration on our state of the art calibration equipment. With the latest software releases and expert technical support, you will save time and money. We offer the following programs:

- Standard Service Subscription; Re-calibration, repair*, cleaning, firmware update and warranty extension when serviced within 12 months subsequent intervals.
- Full Service Subscription; Annual exchange of your flow meter. No service time! Have a fully calibrated flow meter 24/7, 365 days a week!

** Repair within terms of usage, see general terms and conditions.*

Improved software performance, innovative new product features, and technical support helps keep you focused on what matters most for your company.

Benefits

- Annual calibrated and cleaned instruments
- Warranty extension
- Software- and firmware updates
- Live support and e-mail support by our skilled technicians

Consult your distributor for information about our service program.

11 Specifications

Please always check the label of your product for the specifications.
Specifications are subject to change as we are continuously improving our products. Please contact us to obtain the latest specification sheet.

Flow sensor
(minimum detection level and max flow rate shown)

- VPS.R080.M050	0.23...80 m^3_n/hr	0.13…50 SCFM
- VPS.R250.M100	0.91...250 m^3_n/hr	0.54…150 SCFM
- VPS.R01K.M200	3.55...1000 m^3_n/hr	2.15…600 SCFM
Accuracy	0.5% FSS under calibration conditions with calibration report 5% FSS without calibration report	
Reference conditions	0°C, 1013.25 mbar - DIN1343	32°F, 14.65 psi
Gas temperature	0....60°C	32..140°F
Gases	Compressed air, nitrogen, inert gases, 95% non condensing gases	

Pressure sensor

Range	0...16 bar gauge	0…250 psi gauge
Accuracy	+/- 1.5% FSS (0...60°C)	+/- 1.5% FSS (32..140°F)

Temperature sensor

Range	0....60°C	32…140°F
Accuracy	+/- 1° (from 10 m_n/sec and up) (At zero flow conditions, temperature reading increases due to self-heating by the flow sensor)	

Display

Technology	Liquid crystal
Back light	Blue with auto power save
Memory	2 Million point memory option

Mechanical

VPS.R080.M050	135mm x 50mm x 85mm 0.7 Kg	
VPS.R250.M100	135mm x 50mm x 85mm 0.7 Kg	
VPS.R01K.M200	155mm x 90mm x 125mm 1.6 Kg	
IP grade	IP65 when mated to connector, at room temperature; direct rain and sunlight should be avoided. Extreme temperature fluctuations may affect the IP grade over time.	
Ambient temperature	0..60°C	32 .. 140°F

Inputs and outputs

Analog	4..20mA or pulse, selectable via installation software
Serial IO	Modbus RTU USB for configuration (display version only)
Supply	12..24 VDC +-10% CLASS 2 (UL)

12 Order information and accessories

Order Code	Flow range	Option	Display	Option	Connector
VPS.R080.M050	0 ... 80 m^3_n/hr	D0	No display	C5	5 Pin M12
VPS.R250.M100	0 ... 250 m^3_n/hr	D10	Display	C8	8 Pin M12, for remote display *
VPS.R01K.M200	0 ... 1000 m^3_n/hr	D11	Display + 2M point logger		

* The 8 Pin M12 connector can only be used in combination with a D0 model.

Basic features	Display features	Connector types
Thermabridge Flow sensor	3 line display	M12, 5 pin for standard application
Pressure, temperature sensor	Keypad for configuration	M12, 8 pin for remote display function
4..20mA / pulse output (switchable)	USB cable included	
RS485 Modbus RTU	Multi session datalogger (option)	

VPA.0009.001 ISO Calibration report: 5 points, accuracy 0,5% full scale under calibration conditions with air
VPA.5000.911 Bi-directional measurement option

Tubing kits
VPA.1200.005 0.5 inch, in- and outlet tubes
VPA.1200.010 1 inch, in- and outlet tubes
VPA.1200.020 2 inch, in- and outlet tubes

Accesories
VPA.5000.005 Cable, 5m / 16.4 ft with M12 5pin connector on one side, open wires on other side
VPA.5000.010 Cable, 10m / 32.9 ft with M12 5pin connector on one side, open wires on other side
VPA.0000.200 Power supply (12V, 5pin)
VPA.5003.000 RS485 to USB converter
VPA.5001.105 JB5 interface box with 5m / 16.4ft cable + 12 VDC power supply

VPStudio software
SFT.5003.300 Licensed edition VPS&VPT
SFT.5002.400 Full version

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 Measure Monitor Manage

MAN-VP-SINL-UK-1501

Date:19-01-2015